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Advanced Models of Accretion Disk Atmospheres and Spectra for Close Binary Stars

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The Pennsylvania State University
University Park, PA 16802

Richard A. Wade, Principal Investigator
Department of Astronomy & Astrophysics
525 Davey Lab
Pennsylvania State University
University Park PA 16802

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This program, undertaken in collaboration with Dr. Knox S. Long (STScI) and Dr. I. Hubeny (GSFC), applied Hubeny's software for modeling the vertical structure and spectra of accretion disks to the problem of understanding the ultraviolet spectra of cataclysmic variable stars and related objects, such as appear in NASA archival data sets. These data sets include IUE, VOYAGER, and HUT observations. Related work is being carried out under an LTSA grant (NAGW-3171).

Personnel at Penn State associated with the grant are the PI (Wade, throughout) and graduate student Catherine Grant (Summer and Fall 1994).

Early work focused on interpreting the far ultraviolet spectra of novalike variables and dwarf novae. The grant supported modeling efforts by Wade and Hubeny in connection with Long's investigation of the HUT observation of the novalike variable IX Velorum. A paper was published under the LTSA grant describing the observations and analysis in terms of disk models (1993, Ap.J. 426, 704). A display presentation was given at the January 1993 meeting of the AAS in Phoenix (see bibliography below). A second discussion was given at the June 1993 meeting of the AAS in Berkeley, aimed at exploring the variety of spectra produced by disks in the region of the Lyman lines of hydrogen, 911–1500 Å(see bibliography). Modeling of the ultraviolet spectra of accretion disks was also reported in a contributed paper to the San Diego conference on Interacting Binary Stars held in July 1993 (see bibliography).

This work led to the development of code for fitting models to data, and to an understanding of the nature of the models which enabled a more rapid search of "parameter space" for optimal fits to spectral data sets. The code was used to find optimal fits to IUE spectra of quiescent dwarf novae that have been reported to show evidence for the white dwarf. The models consisted of a white dwarf component and an accretion disk with boundary conditions appropriate for the choice of the white dwarf. The preliminary work has strengthened the initial impression that accretion disk spectra can mimic the appearance of white dwarf spectra in the short-wavelength ultraviolet, so that additional constraints (such as distance) are needed to distinguish the two cases. This study motivated the construction of a grid of model disk spectra for the near ultraviolet region, which will be published under the LTSA grant.

A paper on "Synthetic Spectra for Accretion Discs: the UV Absorption Spectrum" at I.A.U. Colloquium 158 (Keele, UK, June 1995) discussed the importance of limb darkening and other effects for the correct interpretation of UV data, and compared model spectra of accretion disks with spectra of stars (see bibliography).

Further work on interpreting the far ultraviolet spectra of novalike variables and dwarf novae resulted in a display presentation at the San Antonio, TX, meeting of the AAS in January 1996 (see bibliography). This work will be published in full under the LTSA grant. The grid of models described above was extended to included several hundred model disk atmospheres computed for 26 different combinations of central star mass and mass accretion rate. Some progress was also made on modeling the ORFEUS spectrum of the dwarf nova Z Cam, observed in outburst. This latter work was in collaboration with Dr. C. Mauche (LLNL) and Dr. M. Hurwitz (UC/Berkeley), but was not completed during the grant period.

The VOYAGER UVS archive of observations of cataclysmic variables was downloaded from the Tucson database, preliminary estimates were made of the quality and usefulness of the various observations, and the times of observation by VOYAGER were correlated with observations by IUE.

Bibliography

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